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ARM Facilities Newsletter

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Micropulse Lidar

The ARM Program studies clouds, sunlight, and their interactions to understand how they affect Earth's climate. One of the many instruments used to look at clouds at the SGP CART site is the micropulse lidar (MPL; "lidar" was coined from "light distance and ranging"). The ARM Program operates five MPLs. One is at the SGP central facility; one is at the North Slope of Alaska CART site in Barrow, Alaska; and three are for use at the Tropical Western Pacific site on Nauru and Manus islands.

The MPL is a remote sensing instrument used to measure the height of overhead clouds and particles (Figure 1). An eye-safe laser in the system directs a beam vertically. As short pulses of laser light travel through the sky, they may encounter water droplets or aerosol particles in the atmosphere. These particles intercept the laser light and scatter it in different directions. Some of the scattered light returns to Earth's surface. A

receiver on the ground collects backscattered light that bounces off atmospheric particles and uses the information to determine the distance between the ground and the particles. The signals detected are collected and plotted (Figure 2). The greater the signal strength, the more scatterers are present in the atmosphere. A plot based on this relationship provides a "snapshot" of the cloud overhead and shows the structure inside the cloud.



Figure 1. The micropulse lidar. The black tube contains an eye-safe laser. The box below houses the computer controls for the system.

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In addition, the information gathered from the MPL can be used to determine the height of the planetary boundary layer, the well-mixed layer of the atmosphere that develops during daytime hours as the sun heats Earth's surface and sets up vertical mixing. Small airborne particles that can also be detected include smoke or dust carried into the atmosphere. This information is valuable to climate researchers.

Because the MPL uses an eye-safe laser, it is not a danger to pilots of planes flying overhead and can be run continuously. The availability of continuous data is a great benefit to researchers in their efforts to incorporate the interactions of clouds and solar radiation into climate models. Another strength of the MPL is long-range detection. The MPL can detect clouds at altitudes above six miles and stratospheric aerosols as high as nine miles.

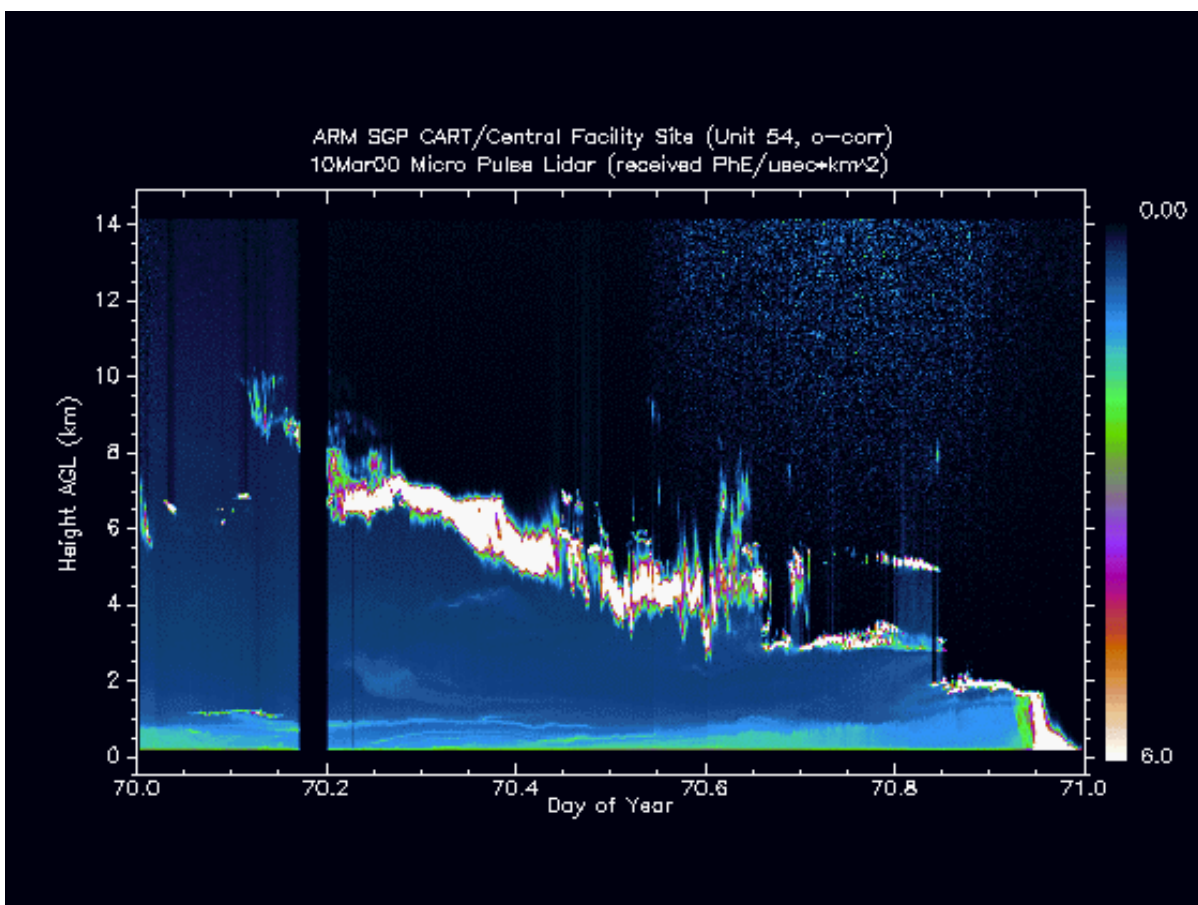


Figure 2. A typical data plot from the MPL at the ARM SGP CART central facility. The white regions denote cloud structures. The time scale reflects a one-day period, with time progressing from left to right (Source: NASA).